Effect of job rotation on need for recovery and (sick leave due to) musculoskeletal complaints: a prospective study among refuse collectors

Kuijer, P.P.F.M.; van der Beek, A.J.; van Dieen, J.H.; Visser, B.; Frings-Dresen, M.H.W.

published in
XVth Triennial Congress of the International Ergonomics Association
2003

EFFECT OF JOB ROTATION ON NEED FOR RECOVERY AND (SICK LEAVE DUE TO) MUSCULOSKELETAL COMPLAINTS: A PROSPECTIVE STUDY AMONG REFUSE COLLECTORS

P. Paul F.M. Kuijer[1,2], Allard J. van der Beek[3], Jaap H. van Dieën[2], Bart Visser[2], Monique H.W. Frings-Dresen[1]

[1]Coronel Institute for Occupational and Environmental Health, *Am*COGG Amsterdam Center for Health and Health Care Research, Academic Medical Center / University of Amsterdam, The Netherlands

[2]Faculty of Human Movement Sciences, Vrije Universiteit Amsterdam, The Netherlands, Amsterdam

[3]Department of Social Medicine, Institute for Research in Extramural Medicine, VU University Medical Center, Amsterdam, The Netherlands

p.p.kuijer@amc.uva.nl

Job rotation might be an effective measure to reduce the risk of musculoskeletal complaints, although its effect has not been established yet. The aim of the present study is to evaluate the effect of job rotation in refuse collecting on need for recovery and (sick leave due to) musculoskeletal complaints.

A one-year prospective study among refuse collectors was performed, using standardised questionnaires. The experimental groups of rotating refuse collectors at t_0 and at t_1 (group R-R) and non-rotating refuse collectors at t_0 and rotating refuse collectors at t_1 (group NR-R) were compared with a reference group of non-rotating refuse collectors at t_0 and at t_1 (group NR-NR).

The adjusted need for recovery of group R-R was marginally significantly lower than need for recovery of the reference group. Groups R-R and NR-R had a more than two times higher risk for complaints of the low back than the reference group. No other significant results were found.

Job rotation seemed to coincide with a reduced need for recovery and was associated with an increased risk of low back complaints. These results might be influenced by the healthy worker selection effect in the reference group and its inverse in the rotating groups.

INTRODUCTION

Refuse collectors around the world are at a high risk for the development of musculoskeletal complaints. Studies from the East (Yang et al., 2001) to the West (An et al., 1999; Dorevitch and Marder, 2001), and from the North (Poulsen et al., 1995; Ivens et al., 1998) to the South (Robazzi et al., 1997; Pimenta Velloso et al., 1997) reported a high risk for musculoskeletal complaints among refuse collectors. The Netherlands forms no exception to this finding (Verbeek, 1991). The high physical workload in refuse collecting is seen as an important risk factor for musculoskeletal and physical fatigue complaints (Poulsen et al., 1995; Frings-Dresen et al., 1995; De Looze et al., 1995; Kuijer et al., 2000, Schibye et al, 2001). Moreover, in The Netherlands the amount of domestic refuse is still increasing. From the year 1993 to 2000 the amount per citizen increased from 478 to about 566 kg. Therefore, interventions should be aimed at reducing the physical workload by a reduction in physical work demands.

In many countries, domestic refuse is collected by a team of a driver and one or more collectors. Therefore, job rotation between driving and collecting might be a widely usable measure. The efficacy of job rotation in refuse collecting between driving a cleansing machine, sweeping streets and collecting polythene bags has already been demonstrated (Kuijer et al., 1999).

To the authors' knowledge, no studies were performed that actually evaluated the effect of job rotation on the occurrence of musculoskeletal complaints. In view of the long latency in the development of musculoskeletal complaints, also the need for recovery was assessed. Insufficient recovery is seen as an important intermediate variable in the development of complaints (Kilbom, 1988; Sluiter et al., 2000).

Therefore, the aim of this study was to evaluate the effect of job rotation between refuse collecting and truck

driving on the need for recovery, the 12-month prevalence of muscuIoskeletal complaints and sick leave due to musculoskeletal complaints.

METHODS

Design and participants

A one-year prospective study among male refuse collectors working with two-wheeled containers was initiated in 1998. Two measurements were performed: at baseline (t_0) and after one year of follow-up (t_1). To evaluate the effect of job rotation, two groups were initially formed. The first group consisted of employees who worked as non-rotating refuse collectors at t_0 and at t_1 (group NR-NR). The second group consisted of employees who rotated between refuse collecting and truck driving at t_0 and at t_1 (group R-R). During the present study, an intermediate group was formed. This group consisted of employees who were non-rotating refuse collectors at t_0 and rotated between refuse collecting and truck driving at t_1 (group NR-R). The first questionnaire was presented to 280 employees working in 23 different companies. At t_0, 243 (87%) questionnaires were completed by 121 non-rotating participants and 122 rotating participants. At t_1, three companies were no longer willing to participate in the study (21 participants). Twenty-five participants were no longer employed by the company. Of the remaining 197 participants, 130 (66%) returned the follow-up questionnaire. Of these 130 participants, 46 belonged to group NR-NR, 63 to group R-R and 21 to group NR-R.

Assessment of (in)dependent variables

At t_0 and at t_1, the participants were requested to complete a questionnaire concerning personal characteristics (age, body height, body mass, the number of working years at the company) and work demands (number of hours collecting per week, number of hours driving per week, number of working hours per week, number of working days per week).

Need for recovery, musculoskeletal complaints and sick leave due to musculoskeletal complaints were also individually assessed using the questionnaire at t_0 and at t_1. The need for recovery was assessed using the 11-items dichotomous scale as developed by Van Veldhoven and Meijman (1994). To assess the 12-month prevalence of low back, neck, shoulder, hand/wrist and knee complaints a Dutch translation of the Standardised Nordic Questionnaire (Kuorinka et al., 1987) was used. Sick leave due to musculoskeletal complaints was assessed using one item (Burdorf et al., 1996). This item assessed whether or not the participant had reported sick due to musculoskeletal complaints in the last 12 months.

Analyses and statistics

First, mean and standard deviation of the personal characteristics (age, body height, body mass and number of working years at the company) and work demands at t_0 (number of collecting hours per week, number of driving hours per week, number of working days per week) of the three groups were calculated. Besides, the mean and standard deviation of the number of collecting hours per week and number of driving hours per week were calculated at t_1 to establish the effect of job rotation. Differences between groups were tested using analysis of variance.

Next, mean need for recovery, 12-month prevalence of the musculoskeletal complaints and 12-month prevalence of sick leave due to musculoskeletal complaints at t_o and t_1 were calculated for the three groups. Crude mean difference scores (DSs) and corresponding 95% confidence intervals (CIs) were calculated for the need for recovery using analyses of variance. Crude prevalence rate ratios (PRs) and corresponding 95% CIs were calculated for the 12-month prevalence of low back, neck, shoulder, hand/wrist and knee complaints and 12-month prevalence of sick leave due to musculoskeletal complaints using Cox's proportional hazards regression analysis with a constant risk period. Cox's proportional hazards regression analysis was performed, because the prevalence of musculoskeletal complaints was relatively high. For both variables (DS and PR), the groups NR-R and R-R were compared with the reference group NR-NR.

Finally, the effect of job rotation on the need for recovery was controlled for possible confounding due to age at t_0, number of working hours per week at t_0, and number of working years in the company at t_0 (adjusted mean DS). The effect of job rotation on (sick leave due to) musculoskeletal complaints was controlled for potential confounding due to age at t_0, (sick leave due to) musculoskeletal complaints at t_0, number of working hours per week at t_0, and number of working years in the company at t_0. A significance level of 5% was used.

RESULTS

Characteristics of participants and work

Group NR-R was the youngest of the three groups with a mean age of 29 years. The groups NR-NR and R-R did not significantly differ in age, on average 34 and 37 years respectively. No significant differences between the three groups were found for the mean values of body height, body mass and number of years working at the company.

The number of hours collecting and driving differed substantially, as could be expected, due to the effect of job rotation. The mean number of hours collecting per week at t_0 was 34, 31 and 15, for group NR-NR, NR-R and R-R, respectively. At t_1 the number of hours collecting for group NR-R had changed to 18. The number of hours collecting per week did not change between t_0 and t_1 for groups NR-NR and R-R. The same effect was found for the number of hours driving at t_0 and t_1. At t_0 the number of hours driving per week for the three groups was 1, 1 and 18, respectively. Due to the introduction of job rotation, the number of hours driving per week at t_1 was 19 for the group NR-R. Again, the number of hours driving per week for the groups NR-NR and R-R did not change between t_0 and t_1. The three groups did not differ on the number of working hours per week and the number of working days per week, on average 41 and 5, respectively

Need for recovery and (sick leave due to) musculoskeletal complaints

When adjusted for confounding, the need for recovery of group R-R was marginally significantly lower than that of the reference group (p-value=0.052). The crude and adjusted need for recovery of group NR-R did not significantly differ from the reference group.

When adjusted for confounding, a significant PR of 2.3 was found for complaints of the low back for group R-R. For group NR-R a significant PR of 2.5 was found for complaints of the low back. The adjusted PRs for the other body regions of the groups R-R and NR-R were not significant. The adjusted PRs for sick leave due to musculoskeletal complaints of the groups R-R and NR-R were also not significant.

DISCUSSION

Is job rotation ineffective?

The aim of the present study was to assess the effect of job rotation between collecting two-wheeled containers and driving a refuse truck on need for recovery and (sick leave due to) musculoskeletal complaints. Contrary to our expectation, we found that both rotating groups had a more than two times higher risk of low back complaints. Does this imply that job rotation is not an effective measure to reduce the risk of musculoskeletal complaints, especially of the low back? Two considerations can be given that support this hypothesis.

First, job rotation probably has no effect on the peak mechanical load during collecting and driving but only on the cumulative mechanical load. In a study on a comparison between peak versus cumulative physical workload risk factors for low back pain, Norman et al. (1998) concluded that cumulative and peak back load provide different information on the risk of back complaints. This may be due to different pathological mechanisms. Therefore, when peak load emerges to be a more important predictor for back complaints than cumulative load, job rotation might be less effective than expected.

Second, truck drivers are exposed to whole body vibration and sit behind the wheel in a relatively static posture. Especially for whole body vibration there is strong evidence that it increases the risk of (low) back complaints (Burdorf and Sorock, 1997; Bernard, 1997; Hoogendoorn et al., 1999). To a lesser extent this holds true for a static work posture (Burdorf and Sorock, 1997). Besides, recent evidence suggests that pushing and pulling is not a risk factor for back complaints (Hoozemans et al., 2002). These two explanations might partly clarify the results of the present study.

Nevertheless, the conclusion that job rotation results in an increased risk of low back complaints appears premature. A major drawback of the design of the present study is its sensitivity to the healthy worker selection effect. The non-rotating reference group may have been relatively healthy and less susceptible to the development of musculoskeletal complaints. This might be caused by either selection at start of employment or drop-out of employees susceptible to complaints in the course of the early years of employment (De Zwart et al., 1997). The results of two other studies on refuse collectors endorse this healthy worker selection hypothesis (Schibye et al., 2001; Lund et al., 2001). Moreover, the opposite may be true for the rotating groups. The presence of, for instance, low back complaints might have contributed to the decision for a new employee or a

refuse collector to become a rotating truck driver. This 'unhealthy' worker selection effect may be present in our study.

Unfortunately, this study remains inconclusive as to whether job rotation between collecting two-wheeled containers and truck driving is an (in)effective measure. However, the results on sick leave due to musculoskeletal complaints and need for recovery may speak in favour of job rotation.

ACKNOWLEDGEMENT

The authors would like to thank the management and the employees of the participating refuse collecting organisations. The Dutch Health Research & Development Council/Medical Sciences (ZonMw) financially supported this study as apart of their program on the 'Effectiveness of interventions to reduce socio-economic differences in health (SEGV II)'. Jitske Groothausen, Marco Hoozemans, Jorrit Jansen, Marianne Six Dijkstra, Judith Sluiter and Marlies Witjes are acknowledged for data collection and processing.

REFERENCES

An H, Englehardt J, Fleming L, Bean J. 1999. Occupational health and safety amongst municipal solid waste workers in Florida. Waste Management & Research 17:369-377.

Bernard BP. 1997. Musculoskeletal disorders and workplace factors: a critical review of epidemiological evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back (report 97-141). Cincinnati: National Institute for Occupational Safety and Health

Burdorf A, Sorock GS. 1997. Positive and negative evidence of risk factors for back disorders. Scan J Work Environ Health 23:243-256.

Burdorf A, Van der Steenhoven GA, Tromp-Klaren EGM. 1996. A one-year prospective study on back pain among novice golfers. Am J Sports Med 24:659-664.

De Looze MP, Stassen ARA, Markslag AMT, Borst MJ, Wooning MM, Toussaint HM. 1995. Mechanical loading on the low back in three methods of refuse collecting. Ergonomics 38:1993-2006.

De Zwart BCH, Broersen JPJ, Van der Beek AJ, Frings-Dresen MHW, Van Dijk FJH. 1997. Selection related to musculoskeletal complaints among employees. Occup Environ Med 54:800-806.

Dorevitch S, Marder D. 2001. Occupational hazards of municipal solid waste workers. Occup Med: State of the Art Reviews 16:125-133.

Frings-Dresen MHW, Kemper HCG, Stassen ARA, Crolla IFAM, Markslag AMT. 1995. The daily work load of refuse collectors working with three different collecting methods: a field study. Ergonomics 38:2045-2055.

Hoogendoorn WE, Van Poppel MNM, Bongers PM, Koes BW, Bouter LM. 1999. Physical load during work and leisure time as risk factors for back pain. Scan J Work Environ Health 25:387-403.

Hoozemans MJM, Van der Beel, AJ, Frings-Dresen MHW, Van der Woude LHV, Van Dijk FJH, 2002. Low-back and shoulder complaints among workers with pushing and pulling tasks. Scan J Work Environ Health 28:293-303.

Ivens UI, Lassen JH, Kaltoft BS, Skov T. 1998. Injuries among domestic waste collectors. Am J Ind Med 33:182-189.

Kilbom Å. 1988. Intervention programmes for work-related neck and upper limb disorders: strategies and evaluation. Ergonomics 31:735-747.

Kuijer P, Frings-Dresen M, De Looze M, Visser B, Van der Beek AJ. 2000. Work situation and physical workload or refuse collectors in three different time periods. Int.J Ind. Erg. 26:509-519

Kuijer PPFM, Visser B, Kemper HCG. 1999. Job rotation as a factor in reducing physical workload at a refuse collecting department. Ergonomics 42:1167-1178.

Kuorinka IAA, Jonsson B, Kilbom Å, Vinterberg H, Biering-Sorensen F, Andersson GBJ, Jorgensen K. 1987. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon 18:233-237.

Lund T, Iversen L, Poulsen KB. 2001. Work environment factors, health, lifestyle and marital status as predictors of job change and early retirement in physically heavy occupations. Am J Ind Med 40:161-169.

Norman RW, Wells RP, Neumann P, Shannon HS, Kerr M. 1998. A comparison of peak vs cumulative physical work exposure risk factors for the reporting of low back pain in the automotive industry. Clin Biom 13:561-573.

Pimenta Velloso M, Moreira dos Santos E, Antonio dos Anjos L. 1997. The labor process and work-related accidents among garbage collectors in Rio de Janeiro, Brazil [Portugese]. Cad Saude Publ 13:693-700.

Poulsen OM, Breum NO, Ebbehoj N, Hansen AM, Ivens UI, et al. 1995. Collection of domestic waste. Review of occupational health problems and their possible causes. Science of the Total Environment 170:1-19.

Robazzi MLCC, Moriya TM, Favero M, Lavrador MAS, Luis MAV. 1997. Garbage collectors: occupational accidents and coefficients of frequency and severity per accident. Ann Agric Environ Med 4:91-96.

Schibye B, Søgaard K, Martinsen D, Klausen B., 2001. Mechanical load on the low back and shoulders during pushing and pulling of two-wheeled waste containers compared with lifting and carrying of bags and bins. Clin Biom 16:549-559.

Schibye B, Hansen AF, Sogaard K, Christensen H. 2001. Aerobic power and muscle strength among young and elderly workers with and without physically demanding work tasks. Appl Ergon 32:425-431.

Sluiter JK, Frings-Dresen MHW, Meijman ThF, Van der Beek AJ. 2000. Reactivity and recovery from different types of work measured by catecholamines and cortisol: a systematic literature review. . Occup Environ Med 57:298-315.

Van Veldhoven M, Meijman ThF. 1994. The measurement of psychosocial job demands with a questionnaire (VBBA) [Dutch]. Amsterdam: NIA Dutch institute for working conditions, 59 p.

Verbeek JHAM. 1991. Disability due to back and other musculoskeletal complaints (PhD thesis) [Dutch]. Amsterdam: Coronel Institute for Occupational and Environmental Health, 166 p.

Yang C-H, Chang W-T, Chuang H-Y, Tsai S-S, Wu T-N, Sung F-C.

2001. Adverse health effects among household waste collectors in Taiwan. Environmental Research 85:195-199.